The upheaval of the stratosphere in the tropics may be demonstrated in a very instructive way by comparison of its height with the height of the cirrus clouds. In my opinion, as indicated below, the base of the cirrus fairly well represents the height of the hypothetical dividing surface between the cooling and heating effect of radiation for moist air (as mentioned in (1)). This surface is one of nearly uniform temperature, as shown by the temperatures of the cirrus level:—

Bossekop (70° N.L.),	height of cirrus 8·3 km.,	temp.	−45° C.
Potsdam (52° N.L.),	,, 9·2	,,	−46° C.
Batavia (6° S.L.),	,, 11·4	,,	−48° C.

Parallel to this surface runs the base of the stratosphere, the analogous dividing surface for atmospheric air (that is, for rather dry air as mentioned in (2)), with a nearly constant temperature of −55° C.

The deviation from this parallel intercourse, which appears in the tropics and subtropics, in consequence of a shifting which only affects the upper surface, gives a direct measurement of the disturbing influence of the vertical convection currents belonging to the general circulation.

In the *Meteorologische Zeitschrift* of 1913 (Heft 10, p. 493) I have already discussed the question of the cirrus level as a dividing surface for radiation effects. In this paper, which may be referred to here, attention was directed to the fact that there exists an essential difference between the cloud formation in the cirrus level and above it, as compared with the lower regions, a phenomenon very evident in the quiet tropical atmosphere. The upper part of the high cumulus clouds (their height may be estimated at about 13 or 14 km.) does not, as the lower part, dissolve rapidly, but assuming a flattened form and cirrostratus-like appearance, it remains drifting along for a considerable time. This difference I attributed to a cloud-dissipating (cooling) effect of radiation in the lower, and a cloud-forming (heating) effect in the upper levels.

As a fixed amount of water radiates and absorbs more strongly in the condensed form than in the gaseous state, in the regions where radiation has a cooling effect, as in the lower strata of the atmosphere, the cooling will be relatively strong in the clouds as compared with the surrounding air. But a heating effect will be experienced in the clouds in higher levels, where radiation is heating them more intensely than the surrounding air. When left to themselves, after convection has finished, they will descend and dissolve in the first case, but, on the contrary, will be upheld or rise, and consequently prolong their existence or develop in the second case.

At that time I had not read Emden's paper. By attributing the relatively low radiation temperatures of the air at these heights to ozone, I tried to explain the circumstance of the different radiation effect observed either with regard to the cirrus clouds or to the air in which they are floating.

Perhaps such an influence cooperates, but Emden's results mentioned above may also explain the matter.

It is very probable that his statement (1) may be applied to clouds on account of their large amount of water in condensed and gaseous form. In this case the limit above which radiation has a heating effect (8950 metres) is indeed situated just below the cirrus level, which at Potsdam has a height of 9200 metres.

As to radiation, the conditions in the surrounding air at this height approach those mentioned in (2), and the radiation effect will still remain a cooling one.

Thus the lower limit of the cirrus clouds may be regarded as the level where, for air of abundant water contents, the influence of radiation changes its sign.

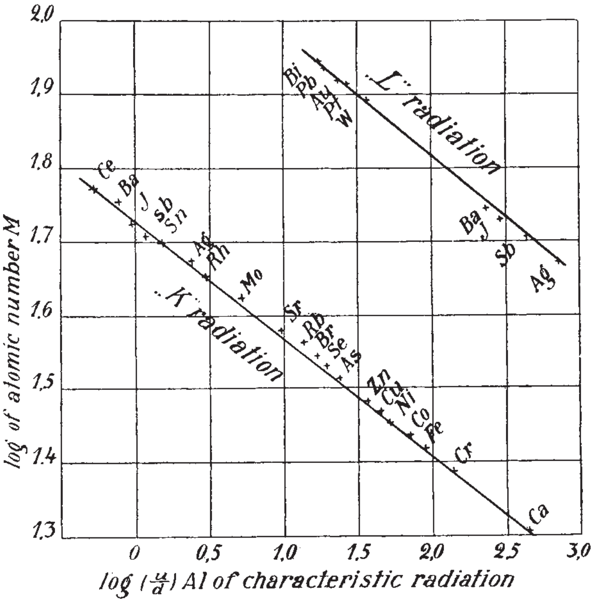
Batavia, January 23. **C. Braak.**

Atomic Models and Regions of Intra-atomic Electrons.

That, as concluded by Prof. Nicholson (Nature, February 5, p. 630) the atoms of lithium, beryllium, and boron cannot consist of 3, 4, 5 electrons rotating round a nucleus of 3e, 4e, 5e, respectively, with equal angular momenta in one circular orbit, may be concluded also from the periodic system, as instead of 1, 0, 1, 2, 3 electrons of valency, we should then expect a regular increase from 0 to 5, or no valency at all. No atomic model, so far as I know, has succeeded in making this difference plausible; but it is not essential to the hypothesis, that, independently of any atomic model:—(i) Three distinct regions of intra-atomic electrons exist, the number of which (say P, Q, R) may be calculated for each atom from the periodic system; and (ii) on these numbers most, if not all, of the non-periodic properties of the elements depend, so that (Nature, December 25, 1913, p. 476):—

(i) $M=P+Q=$(1) the charge on the nucleus on Rutherford's theory; (2) the number of electrons surrounding that nucleus; (3) the atomic number of an element in Mendeléeff's series.

$P=$(1) the number of peripheric electrons (those of valency included); (2) $8r+p$ (p being the maximum valency and r the number of rows preceding that of the element: rare-earth period not counted).



$Q=$(1) the inner electrons, giving probably the characteristic radiation; (2) the number of aperiodic elements (H, He, Co, Ni, &c., and rare-earth elements).

$R=$(1) the free nuclear electrons of which part can be ejected as β rays (Bohr, *Phil. Mag.*, vol. xxvi., p. 501, 1913); (2) $A/2-M$, if the positive part of the nucleus consists of α particles for by far the greatest part; (3) kP^2, as $A/2-M=kP^2$ for all elements (Nature, December 25, p. 476); and that:—

(ii) On M, or some function of it, depend (1) the large-angle scattering of α particles (Nature, November 27, p. 372) (on M^2); (2) wave-number of the characteristic radiation for elements from nickel to zinc (on $(M-1)^2$) (Moseley, *Phil Mag.*, vol. xxvi., p. 1024, 1913); (3) the absorption of the characteristic radiation for all elements (see figure); (4) the minimum velocity of β rays required to produce it (on M or $M-1$); (5) for hydrogen M only gives a possible

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value for the charge, and normal values for absorption, etc., while A/2 does not.

And (iii) on P, or some power of it depend (see table) (1) the percentage of the incident β radiation reflected for UrX, RaE, Act D); (2) the absorption of kathode, or β rays (see Lenard, *Ann. d. Phys.*, vol. lvi., p. 275, 1895, and Crowther, *Phil Mag.*, vol. xii., p. 379, 1906); (3) the number of nuclear electrons and β particles ejected (see Soddy, *Jahrb. Radioakt. und Elektronik*, 1913, vol. x., p. 193); (4) quanta of energy the β particle looses on Rutherford's theory (*Phil Mag.*, vol. xxvi., p. 717, 1913) in traversing the non-nuclear electrons of the atom it came from; (5) probably the decrease of velocity of α particles traversing matter (Bohr, *Phil. Mag.*, vol. xxv., p. 27, 1913). The table gives the number of electrons, causing this decrease, in approximate values.

	P	$\frac{\mu}{D}$	$\frac{10\mu}{NP^2}$	Perc. Refl. β rad.			Perc. Refl. β rad./$P^{\frac{1}{2}}$			N, Bohr
				UrX	RaE	AcD	UrX	RaE	AcD	
Al	11			27	30	38	8·2	9·0	(11·5)	14
Fe	24	6·4	6·2	41	41	47	8·4	8·4	9·6	
Ni	24			43	43	48	8·9	8·9	9·8	
Cu	25	6·8	6·9	43	45	52	8·5	8·9	10·4	
Zn	26	6·95	6·7	43	45	53	8·5	8·9	10·3	
Ag	41	8·3	5·3	55	57	63	8·6	9·0	9·9	
Sn	44	9·5	6·4	57	62	70	8·7	9·4	10·5	38
Pt	56	9·4	5·9	66	68	78	8·8	9·1	10·4	
Au	57	9·5	5·8	68	68	79	9·0	9·0	10·4	61
Pb	60	10·8	6·2	68	70	80	8·8	9·1	10·3	65
Bi	61			70	71	81	9·0	9·1	10·4	
			6·2				8·67	8·98	10·19	

From (ii, 2) $n = c/\lambda = 2{\cdot}465.10^{15}(M-1)^2$; from (ii, 4) $V_{min} = 2{\cdot}24.10^8(M-1)$. Now $V_{min} > v$ of the electron giving K-radiation, and if this $= 1{\cdot}93.10^8(M-1)$, then $mv^2/2n = 0{\cdot}88.1{\cdot}93.^2 10^{-11}/2.2{\cdot}465.10^{15} = 6{\cdot}62.10^{-27} =$ Planck's h.

A. van den Broek.

Gorsel, Holland, February 9.

An Early Slide Rule.

De Morgan, in article "Slide Rule" in the *Penny Cyclopaedia*, points out that though Gunter first used a logarithmic scale, the real inventor of the logarithmic slide was Oughtred. "In the year 1630 he showed it to his pupil, William Forster, who obtained his consent to translate and publish his own description of the instrument, and rules for using it. This was done under the following title, 'The Circles of Proportion and the Horizontal Instrument,' London, 1632; followed in 1633, by an 'Addition, etc.,' with an appendix having title, 'The Declaration of the two Rulers for Calculation.'" After referring to a republication of this work in 1660, he goes on:—"The next writer whom we can find is Seth Partridge, in a 'Description, etc., of the Double Scale of Proportion,' London, 1685. He studiously conceals Oughtred's name; the rulers of the latter were separate, and made to keep together in sliding by the hand; perhaps Partridge considered the invention his own, in right of one ruler sliding between two others kept together by bits of brass."

Prof. F. Cajori, in his book, "A History of the Logarithmic Slide Rule," 1909, the result of an exhaustive inquiry into the literature of the subject, quotes De Morgan, and continues (p. 17), "To Partridge we owe, then, the invention of the slide." In an addendum (p. vi.), and in Nature, February 24, 1910, p. 489, he refers to a copy of Partridge's book in his own possession, published in 1662, in which it is stated that the book was written in 1657.

Dr. Alexander Russell, in Nature, January 30, 1910, p. 307 states:—"A few years before 1671, Seth Partridge rediscovered the sliding principle, perfected it, and gave an almost complete specification for the slide rule which is used to-day by engineers. . . . Personally, I consider that Seth Partridge is the real inventor of the modern 10-in. slide rule."

My object in writing is to direct attention to the fact that there is in the Science Museum at South Kensington a slide rule which is inscribed, "Made by Robert Bissaker for T. W., 1654." This proves that the slide was invented and *in use* three years before Partridge wrote his pamphlet, and eight years before the earliest known date of its publication.

This very early example of the instrument is of boxwood, well made, and bound together with brass at the two ends. It is of the square type, a little more than 2 ft. in length, and bears the logarithmic lines first described by Edmund Gunter. Of these, the *num.*, *sin.*, and *tan* lines are arranged in pairs, identical and contiguous, one line in each pair being on the fixed part, and the other on the slide. As Seth Partridge describes no feature which is not embodied in this example of the instrument, it would appear that less credit is due to him for invention in connection with the slide rule than has hitherto been given.

In this year of the Napier tercentenary celebration it is interesting to know that a slide rule is still in existence which was made only forty years after the invention of logarithms.

David Baxandall.

The Science Museum, South Kensington, S.W.

The Permeability of Echinoderm Eggs to Electrolytes.

In 1910 J. F. McClendon showed that the electrical conductivity of echinoderm eggs is considerably increased after fertilisation, and inferred from this fact that the act of fertilisation causes an increase in the permeability of the egg-surface to electrolytes. In his recent book ("Artificial Parthenogenesis and Fertilisation") Prof. Loeb suggests that the increase in conductivity is not due to an increase in permeability, but would be produced "if in consequence of membrane-formation the degree of electrolytic dissociation of the surface film of the egg should be increased" (p. 122).

I have recently found that the electrical conductivity of unfertilised and fertilised eggs is very greatly affected by the presence of very low concentrations of simple trivalent positive ions; a concentration of 0·0002M $Ce^{\cdots}$ decreases the conductivity of the unfertilised eggs of *Sphaerechinus granularis* by as much as 40 per cent. Such solutions likewise affect the conductivity of the fertilised eggs, but to a less degree. Whereas it is almost inconceivable that these phenomena are due to a decrease in the electrolytic contents of the surface-film of the egg, I have found considerable evidence in support of the suggestion that the electrical conductivity of these eggs is determined, at least partially, by the charge on the egg-surface. As Perrin, Girard, and Mines have shown, this factor also determines the degree of permeability of membranes to electrolytes. In short, McClendon's original contention, that the increase in electrical conductivity of eggs after fertilisation is due to an increased permeability of the egg-surface, is verv much more satisfactory than Prof. Loeb's suggestion.

J. Gray.

Stazione Zoologica, Napoli, Italy.
February 5.

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